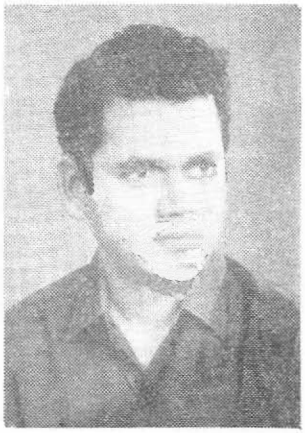

WHAT ARE PEARLS AND HOW ARE THESE PRODUCED?

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A pearl is a gem and there is no place better known for pearls than the neck of a beautiful woman. In early poetic collections of Tamil literature, the beauty of Indian pearls has been mentioned so forcefully that pearls formed one of the earliest objects of India's foreign trade with Egypt, Rome, Greece and China. The ancient Indian sculptures depict Indian women wearing pearls on their body. Pliny, the famous Roman naturalist and philosopher (1st century A. D.) mentions that the wealth of Roman Empire was drained by the habit of Roman women who wore pearls not only on their person but also on their shoes. The old Tamil and Sanskrit literature has been profusely documented with the beauty and preciousness of pearls as gems or jewels. About 6 centuries B. C., King Vijaya of Ceylon is said to have included, among the presents to his father-in-law—the King of Madura, a rich offering of pearls. In "Periplus of Erythraean Sea" written about the 1st century A. D., glorious tributes have been offered to the pearls of Gulf of Mannar.

Pearl-producing areas in India

The pearl oyster is a marine animal belonging to the group commonly known as shellfish or mollusc—mussels, scallops etc. come under the same group. Two regions along the Indian coast have been well known for the pearl oyster resources. One is the Gulf of Kutch along the northern coast of Gujarat and the other is the Gulf of Mannar adjoining the Tamil Nadu coast. Pearls are known

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to be obtained from these two areas since the time immemorial by collecting the oysters from the sea, opening them and searching their tissues. The entire operation has popularly been termed as "pearl fishery".

The early history of the pearl fishery of the Gulf of Kutch is not fully known. In the beginning of this century, the pearl fishery was under the control of the Jam Saheb of Nawanagar and the fishery was conducted under a separate department called "Moti Khata". With the merger of the Nawanagar State in the Indian Union, the pearl fishery came under the control of the Government of Saurashtra and subsequently under the Government of Gujarat.

The early history of the pearl fishery of the Gulf of Mannar, on the other hand, is better known. The fishing for pearls was very intricately connected with the power and might of the Nayaks of Madura, the Nawab of Carnatic and the Portuguese during the 16th century. Several battles were fought between those powers, both on land and at sea, for the control of the area which produced pearls. However, the pearl fishery in 1658 came under the control of the Dutch who allowed free shares to the Nayaks of Madura, the Setupathi of Ramnad, the Nawab of Carnatic and the headmen of the divers, known as "paravas". In 1796, the British took control of the pearl fishery of the Gulf of Mannar, claiming absolute and sovereign rights over all the adjoining districts. The British Government suspended all the privileges enjoyed by the local Rajahs and only gave a little share to the headmen of the divers. During the British rule, 21 pearl fishery operations were carried out, making the city of Tuticorin as the base. In the post-Independence period, the rights over the pearl fishery are being fully exercised by the Government of Tamil Nadu and from 1955 to 1961, there have been 7 fisheries for pearls—one every year. From 1962 onwards, fishing for pearls could not be organised by the Govern nt of Tamil Nadu, as the population of pearl oysters had become very sparse.

Exploitation

The pearl oyster beds of the Gulf of Kutch are locally known as "Khaddas". These are scattered along the intertidal zone of Jamnagar District. The oysters are found strewn along the patchy dead coral reefs and coral debris which are exposed during the ebb tide. The fishery used to be conducted when the oyster population was found to be large. The season generally commenced after the south-west monsoon. The Department of Fisheries organised the operation by engaging fishermen who got paid at the rate of 25 paise for every oyster they collected. The pearls found in the oysters became the sole property of the Government. The pearl fishery of the Gulf of Kutch was held almost every year or alternate years from 1913 to 1939. After 1940, it was held every 3–4 years and from 1967, there has been no fishery at all, as the population of the oysters was found to be seriously depleted. The average number of oysters fished during each season was about 17,000 and the revenue collected by the Government from the value of pearls every year ranged from Rs. 6,000 to Rs. 23,000 between 1950 and 1962.

The pearl oyster resources of the Gulf of Mannar, on the other hand, are of much greater importance by the sheer vastness of the beds. In these, the oysters are always found underwater on submerged reefy or rocky areas at a

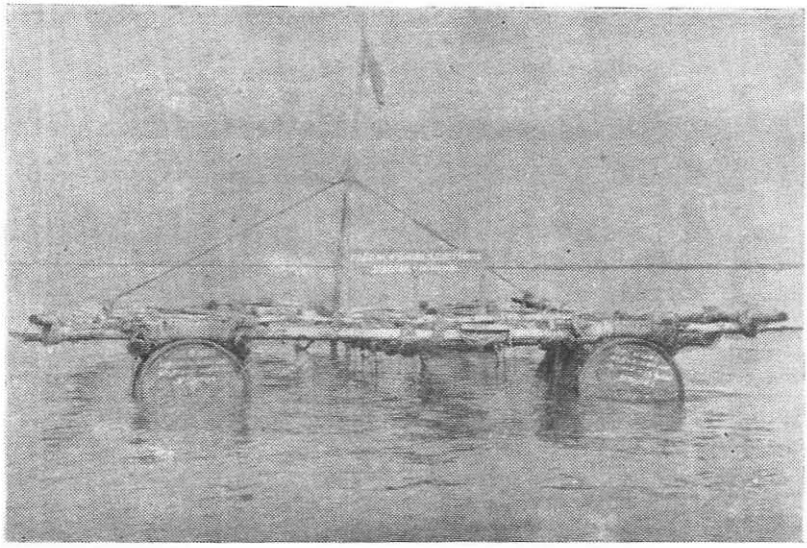

Fig. 1. Raft used by the Central Marine Fisheries Research Institute at the Veppalodai Farm (near Tuticorin) for culturing pearl oysters.

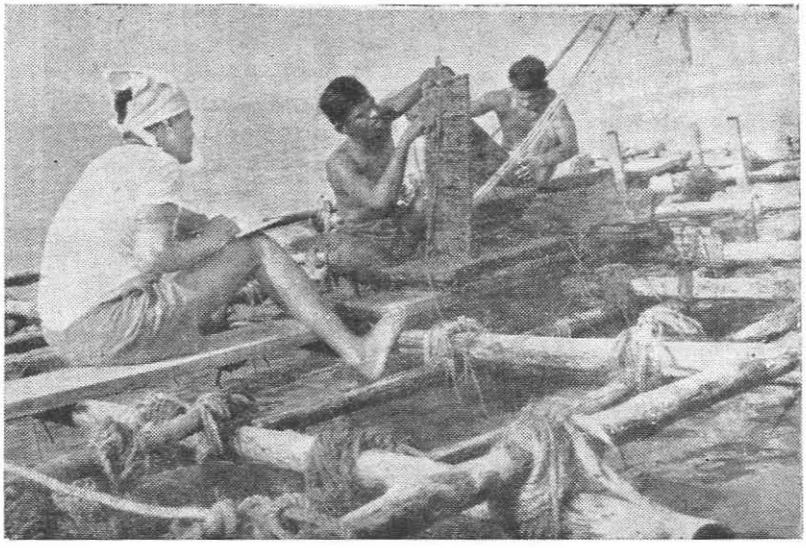

Fig. 2. A close view of the raft showing the scientist at work.

depth of 10–20 m and at a distance of 11–16 km from the coast. The oyster beds are locally known as "paars", and the total number of these paars is more than 60.

The Department of Fisheries, Government of Tamil Nadu, is responsible for the exploitation of pearl oysters from the Gulf of Mannar. Periodic surveys are conducted to estimate the oyster population. When large-sized oysters are available in plenty, the pearl fishery is announced to the public; and boats and divers are registered. The sail boats are towed by powered boats to the oyster beds and the divers collect the oysters by skin-diving. The Government get two-third of the total daily catch of the oysters as their share which is auctioned every evening. The remaining share goes to the divers who sell it directly to the public. Pearl merchants from different parts of India and even from abroad attend the pearl fishery both for trying their luck and for purchasing pearls.

The pearl oyster resources of the Gulf of Mannar have shown wide fluctuations. Being a sedentary animal it has been subjected to indiscriminate exploitation since ancient times. During the span of about 300 years, from 1663 to 1973, there have been 38 recorded fishery seasons. For 27 years before 1955, there was no fishery and since 1961, till now, no fishery has been conducted. From 1955 to 1961, seven fisheries were carried out in consecutive years and the total number of oysters collected in these seven years was more than 86 millions. From these, the revenue collected by the Tamil Nadu Government ranged from Rs. 45,455 in 1956 to Rs. 874,000 in 1959—the total for the seven-year period amounted to Rs. 2,212,581.

To assess the pearl oyster resources of the Gulf of Mannar, an underwater survey programme was undertaken in 1958 by the Central Marine Fisheries Research Institute in collaboration with the Department of Fisheries, Government of Tamil Nadu, using modern method of SCUBA diving. The results of these surveys indicated that the oyster population was badly depleted immediately after the pearl fishery of 1961. The surveys also showed that the contours of some of the oyster beds have changed considerably from what these were known earlier; and a large amount of silting has also taken place in many areas.

Biology of pearl oyster

The pearl oyster, which contributes to the fishery, is *Pinctada fucata*, although five other species occur in the Indian region. The pearl oyster breeds several times in succession. The larvae, on hatching, swim about in the sea forming a part of zooplankton. They feed on microscopic particles (plants, bacteria and detritus) by filtering water. During the planktonic phase, they undergo changes and finally begin to settle to the bottom in large numbers. This phase is commonly known as "spatfall". After settlement, the young oyster begins to grow fast and attains a size of about 50 mm within a year. The adult oyster also feeds on suspended matter in the sea by filtering large quantities of water. The average life span of the pearl oyster is 6–7 years, during which period it attains a size of about 75 mm.

How natural pearls are produced ?

Either accidentally or during the process of feeding, if any living or inert material (parasite, silt or sand particle) gets arrested within the tissues of the oyster, it soon gets embedded and

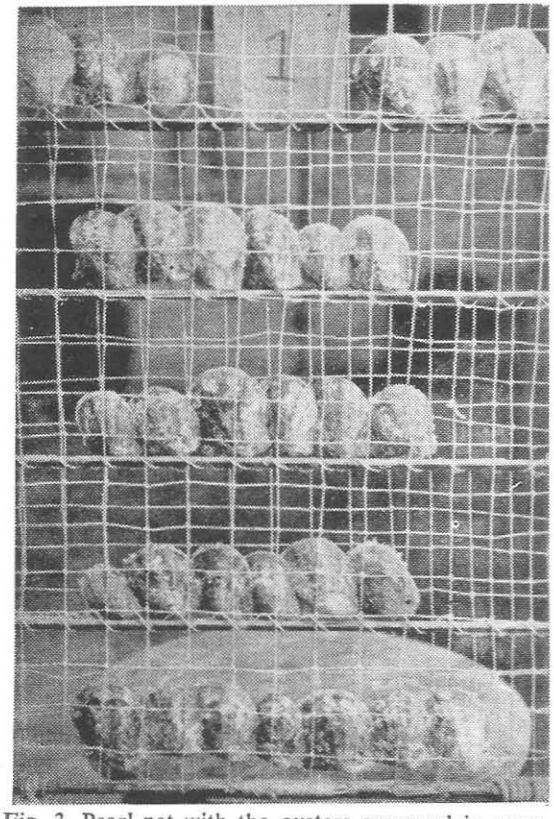

Fig. 3. Pearl net with the oysters arranged in rows.

Fig. 4. An examination of the pearl net containing pearl oysters taken from the raft.

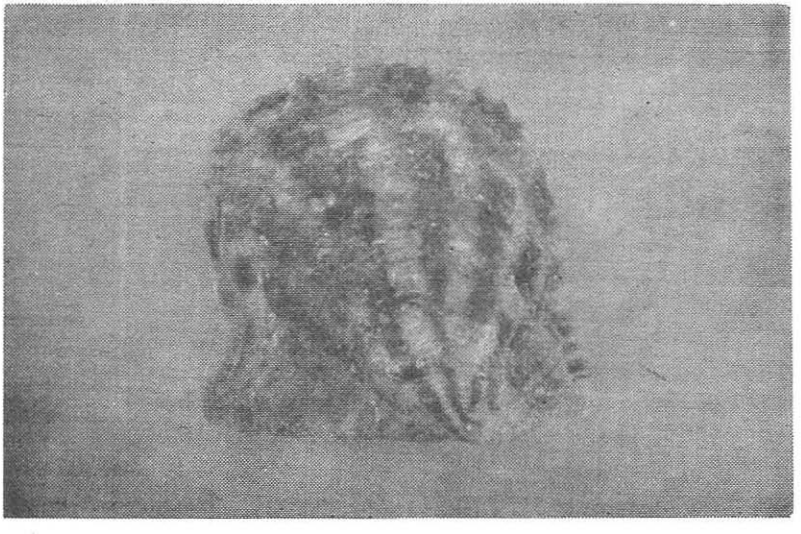

Fig. 5. The pearl oyster *Pinctada fucata.*

begins to act as a nucleus around which a sac is formed. Over the nucleus, the epithelial cells of the mantle begin to secrete nacre or pearly layer. Gradually the nucleus grows larger and larger and finally becomes a pearl. Thus a natural pearl, barring a small nucleus inside — which starts the process, is formed as a result of progressive coating of the nacreous layer. The natural pearl is seldom perfectly spherical, for it normally takes the shape of the nucleus inside. As has been noted earlier, a pearl is a gem and the cost of a natural pearl depends upon its size, shape, colour and lustre. A perfectly spherical pearl is an object of beauty and fetches a high price. It is created by the animal — the pearl oyster — as a result of slow biological process which very often takes most of the life time of the oyster.

How cultured pearls are produced ?

In 1907, Japan, for the first time, developed the technique of producing free, cultured pearls. Since the oyster is capable of retaining solid material as nuclei, it was thought possible to introduce large, perfectly spherical nuclei into the tissues of the pearl oyster so that the nacre or pearly layer could be deposited around these. Thus the cultured pearls are also produced as a result of biological activity of the oyster — the difference between natural and cultured pearls is that in the latter case, the nuclei are introduced by performing a minor surgery on the oyster and these nuclei are either perfectly spherical or of desired shape and size. Thus the nacreous layer deposited around the nuclei is thin as compared to natural pearls, although it has a similar lustre.

For producing cultured pearls on a large scale, pearl oysters are raised in farms in suitable areas in the sea. Two years ago, the Central Marine Fisheries Research Institute selected Veppalodai, about 25 km north of Tuticorin, as a site for the pearl oyster farm. The farm was established in December 1972. Pearl oysters collected from their natural habitat by skin-diving were brought to this farm. They were kept in sandwich-type "pearl nets" made from iron rods, measuring 60 cm x 40 cm in dimensions and partitioned into 5 equal sections; each section was woven with nylon twine of 2 mm diameter to get 2 cm square meshes. The metallic frame was heavily painted with anti-corrosive paint.

The oysters kept in these pearl nets were secured firmly by a twine running all along the four sides of the frame. The nets were then suspended from a raft measuring 6 m x 4.5 m. The frame of the raft was made of wooden poles mounted over wooden barrels or empty metal drums. Planks were fitted on the raft to allow passage and working space for the scientists inspecting the oysters periodically. Each raft could hold upto 30 pearl nets and each pearl net could accommodate 30–50 oysters arranged in 5 rows.

The pearl nets were brought to the field laboratory and examined. The oysters were cleaned of the fouling organisms. Fouling and boring organisms form a serious problem practically throughout the year. However, the overall rate of survival of the oysters was 78% during the year 1972–73.

Healthy oysters were brought from the farm and conditioned in large fibreglass tanks containing well-aerated sea water. They were then anaesthetized in a menthol-sea water solution. When the oysters come under the influence of anaesthesia and the two valves begin to gape, they are fixed on a special stand and the opening of the

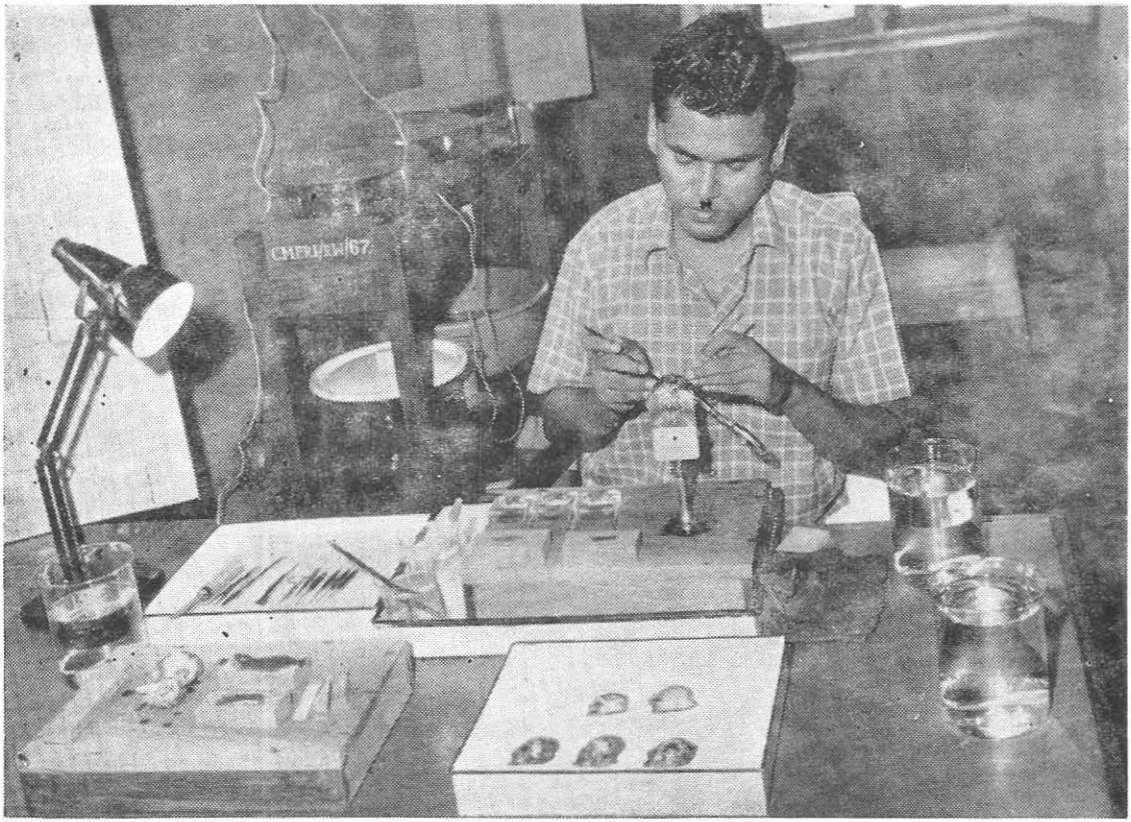

Fig. 6. Implantation of nuclei inside the tissues of pearl oyster.

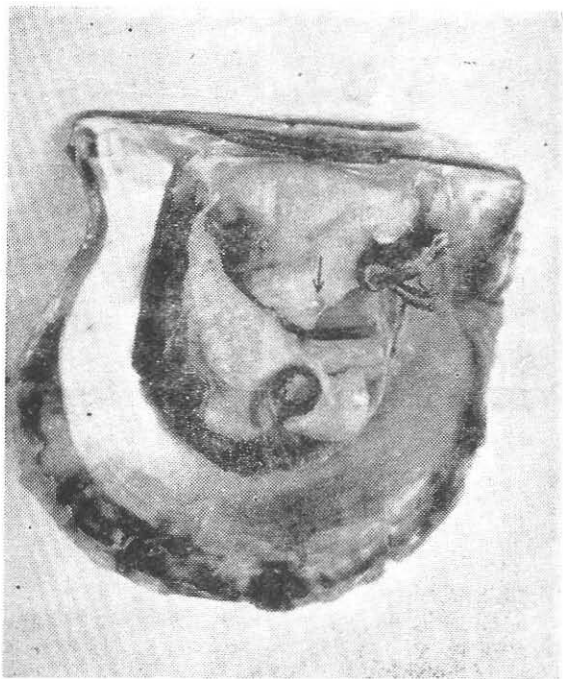

Fig. 7.
A pearl oyster showing
cultured pearl inside its tissues.
The position of the pearl is indicated
by arrow.

valves is regulated with a pair of tongs. An incision is then made at the base of the foot and a small piece of mantle obtained from another oyster and kept ready is introduced into the incision. This is immediately followed by the insertion of a nucleus inside the cut. After the nucleus is implanted, the surgical instruments are withdrawn and the oysters are returned to a basin containing sea water. Several changes of sea water are given during the day of the operation and when the oysters begin to show signs of recovery, they are transferred to a large tank containing well-aerated sea water. A week after the operation, the oysters are arranged in pearl nets and returned to the raft.

The shell-beads used as nuclei in the first few series of experiments were imported from Japan. However, we have achieved success in the preparation of perfectly spherical nuclei from indigenous shells. These nuclei have also been implanted in some of the oysters and have not been rejected.

A few oysters were examined, 30 days after the implantation of the nuclei and then it became quite evident that the deposition of nacreous layer had already started. An examination of the oysters 90 days after the operation fully confirmed the success of the technique used. The pearls obtained were of four colours, golden yellow, pure white, ivory and steel-grey, all with a remarkable lustre. They had grown larger than the nuclei of 3 mm diameter introduced initially. The oysters examined 108 days after the operation had produced even brighter pearls. Nearly 60% of the oysters examined produced pearls and the techniques could further be improved to achieve better results. These cultured pearls are the first of their kind in India. This proves that the oysters of the Gulf of Mannar are capable of producing high quality cultured pearls. In warm waters, like those of ours, the process of pearl formation is much faster than in Japanese waters where the temperature remains low. Hence a good sized pearl in Indian waters can be obtained more quickly than in Japan.

Countries where cultured pearls are produced

As noted earlier, the technology of cultured pearls was first developed in Japan. With considerable refinements in the technique, Japan today produces most of the cultured pearls available in the world. Mikimoto pearls are known the world over. During the last 10 years or so, Australia became the next country to produce cultured pearls on a commercial scale, but the industry was developed in collaboration with Japan. Similarly, in the Philippines, cultured pearls are being produced with the technical assistance provided by Japan.

The Japanese pearl culture industry is at present faced with a serious problem of increasing pollution of sea water associated with a high mortality of oysters in the farm. Consequently in 1970, the rate of pearl production decreased by 27% of that in 1966.

The future in India

Although we have obtained success in the technique of producing cultured pearls and, in doing so, we have joined the list of those few countries in the world where cultured pearls are produced, we should not be carried away by the initial thrill of achieving it first in India. We believe that only the foundation of a technology has been laid and there are considerable refinements in the methodology to be made before the technique is put to commercial use.

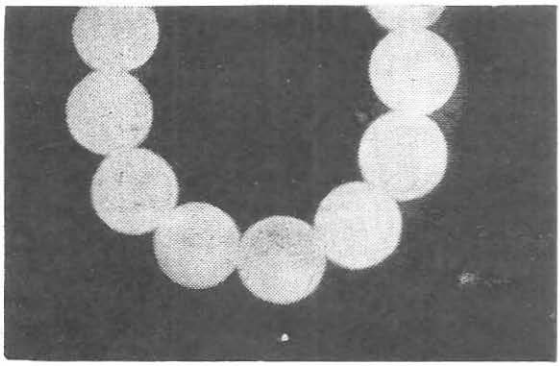

Fig. 8. Some Mikimoto cultured pearls from Japan.

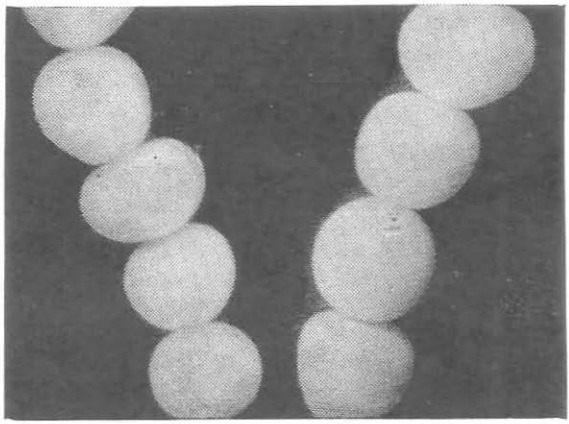

Fig. 9. Large natural pearls, though rare, are generally not perfectly spherical.

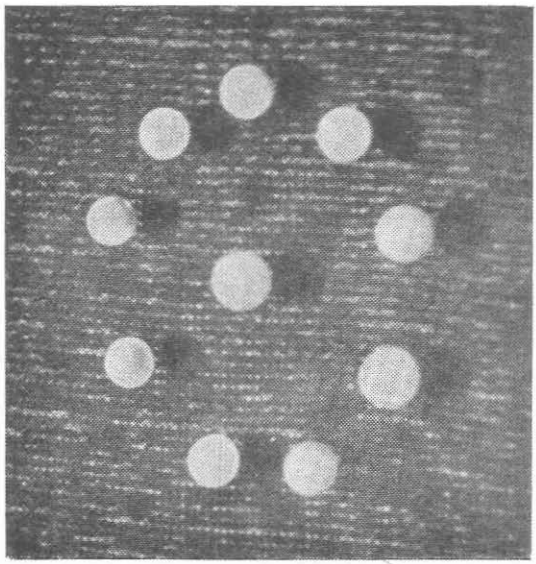

Fig. 10. Cultured pearls obtained at the field laboratory of Central Marine Fisheries Research Institute.

Table 1. **Official figures of imports and exports of pearls into and from India**
(Value in 1000 Rupees)

	IMPORTS					EXPORTS				
	1968-69	1969-70	1970-71	1971-72	1972-73	1968-69	1969-70	1970-71	1971-72	1972-73
Natural pearls unworked	1,973	5,312	3,679	3,080	N.A.	5,992	7,483	5,158	6,293	4,892
Natural pearls worked	214	74	—	—	N.A.	884	1,560	4,535	2,330	4,833
Cultured pearls unworked	6,538	3,942	4,599	3,295	N.A.	221	153	398	124	506
Cultured pearls worked	—	7	68	36	N.A.	34	62	173	14,358	10,395
Total	8,725	9,335	8,346	6,411	N.A.	7,131	9,258	10,264	23,105	20,626

N. A. — Figures not available.
Source: "Monthly Statistics of the Foreign Trade of India" published by the Directorate General of Commercial Intelligence and Statistics.

Our experiments have opened possibilities in two major directions :

(1) Revival of the pearl oyster resource by aquaculture;
(2) Potential of producing cultured pearls.

A full-scale revival of the pearl oyster resource will have to be made both by collecting the natural spatfall of oysters and by applying hatchery operations — that is, by making the oysters breed in captivity, rearing the larvae in hatcheries, collecting the spatfall on frames and culturing them on a large scale on rafts. This would ensure a steady supply of mother-oysters for pearl production.

The second aspect would require a team of trained staff for the implantation of nuclei, looking after the well-being of oysters and finally the development of harvesting technique for pearls from the oysters using automatic gadgets.

The pearl trade of India is of considerable magnitude involving foreign exchange as can be seen from Table 1. The skilled craftsmen of India do a fine job of processing the pearls and setting them into various items of jewellery. Moreover, persons visiting Japan and other countries bring pearls and necklaces into India as presentation articles of much value.

We hope that, with our success in developing the cultured pearl technology and with the proposed intensification of further investigations in this field, the future of cultured pearls in India is as bright as the pearls themselves. ●